The Hon Sussan Ley MP, Minister for the Environment

The Hon Meaghan Scanlon MP, Minister for the Environment and the Great Barrier Reef and Minister for Science and Youth Affairs

Dear Ministers,

Please find attached the Independent Expert Panel's advice explaining that the Great Barrier Reef is not one homogeneous entity; all its components are necessary for ecological function. The advice is attached with key points summarised below. This follows on from our advice on how coral community composition has changed in recent times. Both pieces will be made publicly available on the Panel's page of the Department of Agriculture, Water and the Environment's website.

**The Great Barrier Reef (GBR) is more than coral: it is a complex ecosystem including thousands of different species, and all of them are important.**

The GBR is not one entity. It is a remarkable complex of interrelated systems, with a high degree of mutual dependence – for survival and function. The component parts must all be protected to safeguard the GBR and its prevailing benefits to society into the future.

- The GBR is the largest single ecosystem in the world.
- It is not one reef but comprises more than 3000 coral reefs and includes a connected mosaic of more than one thousand islands and non-reef habitats ranging from shallow estuaries to deep oceanic waters.
- Seventy different bioregions have been identified; 30 reef and 40 non-reef bioregions.
- The thousands of species – corals, fish, birds, plants, and their habitats, contribute to the Outstanding Universal Value of the Great Barrier Reef World Heritage Area.
- The GBR's iconic cultural, economic and social values to indigenous communities, and in supporting local and regional economies, are intrinsically tied to the survival and function of the GBR as a whole.
- The capacity of the GBR to continue to generate these benefits – directly and indirectly – faces a range of increasing threats which vary in size, location, and timeframe.
- The five major threats to the health of the GBR are climate change, coastal development, terrestrial run-off, fishing and crown-of-thorns.
- Seagrass ecosystems are distributed throughout the GBR, with inter-tidal and sub-tidal systems mostly located in inshore areas and associated with large reefs. Vast deepwater seagrass meadows are found in mid-shelf and offshore areas. Seagrasses provide important habitats for fish and iconic species such as turtle and dugong.
- The GBR is ecologically connected with, and some species are dependent upon, the adjacent catchment areas. For example, floodplains, river systems, wetlands, saltmarshes and mangrove ecosystems provide habitat and linkages that are vital for many species of fish and marine mammals, as well as moderating the distribution and cycling of nutrients and sediments.
- The GBR ecosystem will fail unless all catchments are effectively managed.

I am happy to provide further detail on these matters if required.

Yours sincerely,

Em Professor Ian Chubb AC FAA FTSE FACE FRSN

7 April 2021

Cc: The Hon Warren Entsch MP

The Hon Penny Wensley

## The Great Barrier Reef is more than coral: it is a complex ecosystem including thousands of different species, and all of them are important.

The Great Barrier Reef (GBR), the largest reef ecosystem in the world, extends off the Queensland coast for some 2300 kilometres from the tropics to the sub-tropics over an area larger than Victoria and Tasmania combined, or Italy.

This vast ecosystem is much more than its > 3000 coral reefs. Most of it is made up of a connected mosaic of more than one thousand islands and non-reef habitats ranging from shallow estuaries to deep oceanic waters. These coastal and inter-reefal habitats support migrating species as they move from inshore nursery grounds to the offshore reefs. For example, red emperor snapper spawn near the edge of the continental shelf and recruit to coastal estuaries as larvae. Juveniles move from this recruitment habitat to reefs and inter-reefal habitats as they mature (Hutchings et al. 2019). All the habitats from the estuaries to the oceanic areas need to be healthy for the reef ecosystems to function.

The GBR contains numerous globally significant habitats for the *in situ* conservation of biological diversity. Seventy different bioregions have been identified; 30 reef and 40 non-reef bioregions (Day 2019). This habitat diversity is enabled by the exceptional size of the GBR (350,000 $km^2$), its latitudinal extent from 10$^o$S to 24$^o$S, the movements of coastal and off-shore currents and the latitudinally diverse gradients across the continental shelf from the coast to deep oceanic waters up to 400 km offshore.

In addition to more than 400 species of reef building corals (Wallace 2019), this ecosystem supports extraordinary numbers of species and ecological communities including:

- some of the world's richest mangrove communities representing more than 50% of the world's genetic variation in mangrove plants (Duke and Larkum 2019)
- extensive meadows of some of the most biodiverse seagrass communities in the world, which are not only nursery grounds for many commercial fish species, but also globally significant feeding grounds for threatened mega herbivores such as dugongs and green turtles (Duke and Larkum 2019)
- carbon stocks and sequestration associated with mangroves, seagrass and saltmarsh (UNESCO 2020)
- over 880 species of algae (Diaz-Pulido 2019) including banks of the green calcareous algae *Halimeda,* that extend for thousands of square kilometres (Bridge et al. 2019*)*
- 1625 species of bony fish including some 157 non-reef species (Choat et al. 2019)
- 135 species of sharks and rays (Choat et al. 2019)
- six of the world's seven species of marine turtles, including globally important breeding and feeding grounds for five of them (Marsh et al. 2019)
- more than 200 bird species, including large numbers of migratory waders and 20 species of nesting seabirds -1.7 million individuals (Congdon 2019)
- more than 30 species of marine mammals, including globally significant populations of the dugong, two species of coastal dolphins endemic to the Sahel shelf and a still undescribed sub-species of minke whale (Marsh et al. 2019)
- seabed habitats that support more than 5000 species (Pitcher et al. 2019), and
- numerous undescribed species in most of these groups.

All these species and their habitats are attributes of the Outstanding Universal Value of the Great Barrier Reef World Heritage Area (Lucas et al. 1998), that Australia, as a signatory to that *Convention Concerning the Protection of the World Cultural and Natural Heritage 1972*, has an obligation to protect.

Just like the GBR itself, the values – monetary and otherwise - generated by the GBR vary enormously across society. Estimated values vary substantively depending on assumptions and what is included but asset values always range in the 10 to 100's of billions (e.g. $56bn, Deloitte 2017) supporting tens of thousands of jobs and billions in economic value every year (e.g. $6.4bn, Deloitte 2017) . Like an orchestra, everyone has their favoured section – yet the whole of the GBR must be functional for these values to be enjoyed. Indigenous peoples up and down the reef value their continued connection to their Land and Sea Country in ways that cannot simply be converted to dollar values and reflect local traditional uses. The GBR and its natural values are valued by locals, all Australians and people around the world – both for the knowledge it exists and to pass on to our children. Local residents tend to value the GBR more highly, but the iconic value drives substantial values to all Australians (Rolfe and Windle 2012).

Existence values are difficult to separate from the more concrete economic value of the reef that comes from visiting and enjoying the experience in person – generating tourism and flow on revenues across the towns and cities of the GBR coast and beyond (Stoeckl et al. 2014). The tourism experience and value differs across the reef – from north to south – with visitors to the north tending towards shorter stays and higher valuing of the nature experience over those in the south (Esparon et al. 2015).

Reef users also differentiate between different experiences, valuing different ecosystems for different reasons (Marshall, Dunstan *et.al.* 2019). These authors suggest that residents experience and visit beaches and creeks but have less direct connection to offshore areas. Visitors tend to value larger marine animals such as whales, dolphins, sharks and rays above turtles and large fish (Farr *et.al.* 2014). Unsurprisingly, recreational fishers describe higher values for higher catch rates and particular species (e.g. red emperor) and disbenefits from algal blooms (Prayaga et al. 2010).

The five major threats to the health of the GBR are climate change, crown-of-thorns starfish, coastal development, terrestrial run-off, and direct uses (such as fishing). The impacts of these threats vary across the Reef and operate at different spatial and temporal scales, leading to a diverse risk and vulnerability profile for each threat.

Consider the complex effects of land-based run-off. Thirty-five major river catchments drain into the GBR region, with varying flow frequency and intensity. In some locations between Lizard Island and Townsville, mid-shelf reefs are directly affected by land-based run-off, but sediments carried by flood plumes generally settle within 50 kilometres of river mouths. So terrestrial run-off predominately affects coastal ecosystems, such as wetlands and seagrasses. But these coastal ecosystems support the health of the whole GBR through numerous biological, physiochemical, and biogeochemical processes and ecosystem functions.

The effects of climate change are even more complex. The frequency and severity of climate change impacts, such as rising water temperatures, are increasing and interacting with the other key threats, which compounds the impacts of climate change. Sediment pollution from terrestrial run-off, for example, is expected to increase with the predicted increase in severity of extreme weather events due to a changing climate. A key concern is the impacts of climate change on species, such as corals, seagrasses, and mangroves, which form habitats for other species. Declines in the habitat-forming species in turn reduce the abundance or condition of dependent species and ecological communities.

For example, inshore seagrass beds had already declined due to poor water quality caused by terrestrial runoff associated with a series of wet summers, when Category 5 Cyclone Yasi crossed the coast in early 2011, severely damaging the seagrass beds in its path. The resultant further loss of their seagrass food caused a record number of sick, moribund and dead dugongs and green turtles to strand in the southern GBR Region in 2011 (Meager and Limpus 2014); the surviving dugongs stopped breeding for several years (Fuentes et al. 2016).

There is a very real danger that the combination of threats to the GBR will continue to weaken the resilience of this ecosystem. This would further reduce the GBR's ability to recover from increasingly frequent and severe environmental disturbances, such as mass coral bleaching events caused by global warming.

Everyone experiences loss when the health of the GBR is damaged – but not everyone feels the same sense of loss. Tourists and residents tend to feel loss more strongly and identify more closely with place – a specific location – on the GBR (Marshall, Adger et al. 2019). Beaches and inshore areas are particularly subject to loss of value to residents and tourists due to poor water quality and litter (Rolfe and Gregg 2012, Esparon et al. 2015). Loss of corals and reef fish abundance has a similar effect on the likelihood and benefits from reef trips to offshore areas (Kragt et al. 2009, Marshall, Adger et al. 2019).

The GBR has many values – natural, Indigenous, social, economic, historic. These values face a range of increasing threats that are highly variable in size, location, and timeframe. Given the inherent complexity of the GBR, the diverse values of the GBR and the interacting, cumulative impacts of the threats, different parts of the Reef should not be managed in isolation. Instead, the GBR must be managed through a coordinated combination of Reef-wide, regional, and local actions. A coordinated strategy is the best way to counter the threats and preserve the Outstanding Universal Values of the Great Barrier Reef.

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